Project Code and Title

B.01.14 Child Safety Rulemaking - FMVSS No. 213 Upgrade

Project Objective

The objective of this program is to provide support for Rulemaking's potential upgrade of FMVSS No. 213, in an effort to provide increased safety for children positioned in child restraint systems and thereby reduce the number of children killed or injured in motor vehicles.

Background

Use of child restraints is now required in all 50 states and the District of Columbia. Data indicate that the combination of high-quality child restraints and the increased us of these restraints as a result of the mandatory usage laws has significantly reduced the risk of child fatality in motor vehicle crashes. Most child restraint usage laws were not in existence at the time FMVSS No. 213 was promulgated. Because of this fact, NHTSA intends to upgrade FMVSS 213 to address child safety issues which warrant rulemaking action.

Problem Definition

Even with the existence of the child restraint laws, changes in child restraints and motor vehicle technologies (e.g. air bags) have been affecting the type and level of protection child restraints provide to children of various ages. Changes in motor vehicle seat and belt designs and configurations is another problem that affects the performance of child restraint systems during crashes. Further, with new child restraint technologies, such as universal child restraint anchors (UCRA), considerations such as type of anchorages may be of concern as it relates to side impact protection. Finally, there are concerns about the compatibility of child occupant protection in aircraft and school bus environments that need to be considered.

Research Approach

Potential upgrades to FMVSS No. 213 will be evaluated by conducting component level and dynamic sled testing.

Potential Impact/Application

Upgrade of FMVSS No. 213

Key Milestones

- Final Rule requiring compliance testing of belt positioning booster seats, July 1994
- Final Rule adding 3 child dummies to compliance test procedure, July 1995
- Planned NPRM to allow installation of UCRA system(s), Late 1996

RESOURCE REQUIREMENTS	FY92	FY93	FY94	FY95	FY96
Contract Money ($K)	209	176.5	150	164.6	185

Project Manager(s)

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Completion Date

Research Program Date - September 1997

Publications

1. Hiltner, "Evaluation of Booster Seat Suitability for Children of Different Ages and Comparison of Standard and Modified SA103C and SA106C Child Dummies," NHTSA Final Report DOT HS 807 844, February 1990.

2. Pritz and Wade, "Technical Support to the Six-Year-old Dummy NPRM," NHTSA Final Report DOT HS 807 806, October 1990.

3. Hiltner, "Newborn Infant Dummy Development and Evaluation," NHTSA Final Report DOT HS 807 383, February 1991.

4. Howe, Chambers and Sullivan, "Assessment of Interior Dimensions and Lap/Shoulder Belt Fit," NHTSA Final Report DOT HS 808 003, October 1992.

5. Sullivan, "Child Restraint/Passenger Air Bag Interaction Analysis," NHTSA Final Report DOT HS 808 004, October 1992.

6. Howe and Sullivan, "Evaluation of Belt Positioning Booster Seats and Lap/Shoulder Belt Test Procedures," NHTSA Final Report DOT HS 808 005, October 1992.

7. Sullivan and Stucki, “Evaluation of Effects of FMVSS 213 Seat Back’s Flexibility on Booster Seat Responses,” NHTSA Final Report DOT HS 808 006, October 1992.

8. Duffy, “Evaluation of Front Seat Back Force/Deflection Characteristics,” NHTSA Final Report DOT HS 808 007, October 1992.

9. Klinich and Sullivan, “Booster Seat Evaluation: Belt Anchorage Location Effect and Performance in Rear-Facing Seats,” NHTSA Final Report DOT HS 808 092, September 1993.

10. Sullivan, Mouchahoir, Stucki, Howe and Chambers, “Assessment of Dynamic Testing Environment of Child Restraint Systems,” SAE Paper 933134, SAE Publication SP-986, 37th Stapp Car Crash Conference, San Antonio, TX, November 7-8, 1993.

11. Mouchahoir and Sullivan, “Interaction of Air Bags and Child Restraint Systems,” Paper 94-S10-O-04, 14th International Conference on Enhanced Safety of Vehicles, Munich, Germany, May 23-26, 1994.

11. Sullivan and Chambers, “Evaluation of Devices to Improve Shoulder Belt Fit,” NHTSA Final Report DOT HS 808 383, August 1994.

12. Mouchahoir and Sullivan, “Engineering Factors Affecting the Design of Multi-Modal Child Restraint Systems,” Paper 96-S7-W-18, 15th International Conference on Enhanced Safety of Vehicles, Melbourne, Australia, May 13-17, 1996.

13. Sullivan and Chambers, “Evaluation of Aftermarket Devices to Reposition Shoulder Belts,” Paper 96-S7-O-01, 15th International Conference on Enhanced Safety of Vehicles, Melbourne, Australia, May 13-17, 1996.

Keywords: child restraint, child seat, belt positioning device, school bus seat, commercial aircraft seat, side impact air bag

Project Tasks

Task	Title and Description
Task 1.0	**Evaluation of Universal Child Restraint Anchor (UCRA) Systems:** Work will be conducted to evaluate these types of systems under FMVSS No. 213. Both the vehicle and child restraint components of the anchorage devices will be statically evaluated to determine the anchorages' sustainable force levels during both planar and torsional loading. HYGE sled tests using the UCRA systems on a modified FMVSS 213 seat fixture and/or a generic rigid seat fixture will be conducted to assess how well the restraints perform under compliance conditions. Performance of the child restraint using the UCRA system(s) will be compared to that of the CRS when tested with the vehicle's belt restraint system.
Task 2.0	**Development of CRS/Vehicle Compatibility Database and CD-ROM:** A database will be created in an effort to provide the public with information on the compatibility of child restraints with various vehicle seating positions. Incompatibility is a significant and growing problem. The Agency needs to be able to expediently assist the public on where CRS can and cannot be properly installed in vehicles. Not only will the information collected identify suitable/unsuitable seating positions for use, it will also identify methods to correct installation problems (i.e., usage of tethers, necessary supplemental vehicle hardware, etc.).
Task 3.0	**Evaluation of CRS in Aircraft Seats:** In response to the FAA's request that FMVSS No. 213 be amended to required dynamic certification of CRS for commercial aircraft usage, a series of HYGE sled tests will be conducted to determine if CRS adequately safeguard children when in the aircraft environment. Currently, FMVSS 213 only requires a static rollover test to be performed with the CRS for aircraft certification. FAA's CAMI conducted a series of sled tests and found that several of the forward facing seats resulted in HIC values over 1000. CAMI also identified problems with small shield booster seats and plans to promulgate rulemaking to ban the use of these types of boosters and belt positioning booster seats on aircrafts. In response, NHTSA will amend FMVSS 213 labeling requirements for aircraft certification with these seats.

Task 4.0 **Evaluation of CRS Installed in School Bus Seats:** Up to 89% of the U.S. school districts transport preschool aged children on large school buses each day to and from programs such as Head Start and infants/toddlers programs for teenage mothers. FMVSS No. 222, "School Bus Passenger Seating and Crash Protection", contains the specifications for school bus manufacturers that provide for the passengers' occupant protection, by requiring closely spaced, well anchored, padded energy absorbing seats and barriers. FMVSS 222 was developed based on occupants ranging in size from the six year old child to the adult male. No information is available to determine if the crash protection provided by FMVSS 222 is adequate for smaller children or, if not, what is the best way to transport preschool age children in large school buses. Generic HYGE sled tests will be conducted to provide insight as to (1) the best way to transport preschool aged children, and (2) the effect of using safety belts on large school buses. The effect on occupant performance of raising the height of the school bus seat backs and barriers will also be investigated.

Task 5.0 **Potential Upgrade of FMVSS No. 213 Bench Seat Fixture:** This task aims at designing and developing a bench seat fixture that is more representative of the seat geometry for the current vehicle fleet. Accident files will be searched to determine the seating position of children and the injury/fatality exposure and risk for these occupants. HYGE sled tests will then be conducted with various dummy/child restraint configurations to evaluate this fixture and compare its performance with the current FMVSS No. 213 bench seat fixture.

Task 6.0 **Evaluation of Aftermarket Devices to Reposition Shoulder Belt:** Several types of devices marketed for use by older children, and adults of small stature, to reposition the shoulder belt for a more comfortable fit will be tested using FMVSS No. 213 parameters (i.e., seat fixture, pulse, velocity). Three different sized dummies will be used as test surrogates.

Task 7.0 **Evaluation of Potential Interaction Between Child Occupants and Side Air Bag Restraints:** With the introduction of side air bag restraints, concern has arisen as to how they will interact with certain occupants. This task will specifically look at possible problems that could occur with children seated next to the air bags, by conducting static surveys of the relative positioning between the air bag restraints and both children and adults.

Task 8.0 **Evaluation of Effects of Forward Mounted Anchorage Points on Child Restraint Performance:** Safety belt anchorages of newer model vehicles more frequently being positioned forward of the seat bight (i.e., intersection of the seat back and seat cushions) to provide improved fit and performance for larger occupants. This relative positioning is compromising the compatibility, stability and performance of child restraints. Results of earlier Agency testing illustrate the potential danger for children when a child restraint is installed in vehicles with forward mounted anchorages. A small series of tests will be conducted using child restraints, with and without tethers, installed in seats with forward mounted anchorages at varying amounts from the seat bight.

Task	Start Date	Projected Completion Date	Status/Responsibility
1.0	2/96	12/96	Ongoing / VRTC Contractor & Sullivan
2.0	4/95	12/96	Ongoing / VRTC Contractor & Sullivan
3.0	2/95	11/96	Ongoing / Sullivan
4.0	5/96	11/96	Ongoing / Sullivan
5.0	9/96	6/97	VRTC Contractor & Sullivan
6.0	11/93	8/97	Phase I Completed 8/94; Phase II - Sullivan
7.0	1/97	6/97	VRTC Contractor & Sullivan
8.0	11/96	5/97	Sullivan

Supporting Contracts

Task	Contract Number	COTR (phone)	Contracting Officer (phone)	Total Contract Cost ($K)
1.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$150.5
2.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$165
3.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$ 95
4.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$ 90
5.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$140
6.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$100
7.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$ 64
8.0	VRTC	Lisa Sullivan (513) 666-4511	Robin Esser (513) 666-4511	$ 80.6